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09/927,428	08/09/2001	Wenbing Yun	LBL-IB-1498	6387

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EXAMINER

DEO, DUY VU NGUYEN

ART UNIT

PAPER NUMBER

1765

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62

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/927,428

Applicant(s)

YUN ET AL.

Examiner

DuyVu n Deo

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 June 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-80 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-80 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- ☐ Interview Summary (PTO-413) Paper No(s). _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

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DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 23, 50, 76 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicant has not shown where in the specification teaching of the aspect ratio of the etched portion of said wafer to that of said etched pattern is substantially greater than one.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 23, 50, 76 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 23, 50 and 76 are vague and indefinite because applicant has not explained what part of the etched portion is being comparing to that of the etched pattern. The width, area, or depth? It is unclear how to compare the ratio of an etched portion to an etch pattern when the etched portion would correspondent to or depend on whatever the etched pattern is and appears

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to be the same as that of the pattern. At this time, the etch portion would be understood as to be the same as that of the etched pattern.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 1, 2, 7-11, 16, 18, 23, 28, 29, 34-38, 40, 41, 43, 45, 50, 55, 60, 61, 63, 64, 66, 67, 69, 71, 76 are rejected under 35 U.S.C. 102(b) as being anticipated by Zandveld (US 4,104,085).

Zandveld describes a method for etching a substrate comprising: bombarding the surface of the wafer having a silicon (di)oxide layer with argon ions having energy of at least 20 keV with the depth depending on the ions concentration and energy (claimed irradiating the wafer surface with a charged particle beam of suitable energy) and this would form claimed particle tracks; forming a pattern photoresist on the irradiated wafer surface; etching the wafer with a solution according to the etching pattern (col. 3, line 50-col. 4, line 50; figure 1-5).

Referring to claims 2, 10, 29, 37, 38, 55, 63, 64 figure 2 shows the charged particle beam is of predetermined collimation and at a desired direction (perpendicular) with respect to the wafer surface.

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Referring to claim 9, the argon ions are used for the ion implantation (col. 3, line 64-68). This would read on claimed charged particle beam is produced by removing some or all electron from neutral atoms. Method, such as using an accelerator, to produce such ions are known by one skilled in the art as shown in page 9, line 1-2 of specification.

Referring to claims 13, 40, 66 figure 2 shows that the particle tracks would be formed substantially parallel to each other. Claims 14, 41, 67 do not have patentable weight because it is an optional limitation.

Referring to claims 23, 50, and 76, the since the etched portion would have to be correspondent to that of the etched pattern, it would be the same as that of the etched pattern.

3. Claims 1-4, 7, 8, 10, 14, 16, 18, 28-31, 34, 35, 37, 41, 43, 45, 55-57, 60, 61, 63, 67, 69, 71 are rejected under 35 U.S.C. 102(e) as being anticipated by Liu et al. (US 6,271,127).

Liu describes a method for forming dual damascene comprising: exposing the substrate surface with and electron beam or ion implantation with suitable energy (claimed irradiating the wafer surface with a charged particle beam of suitable energy) and this would form claimed particle tracks with a desired depth and alignment; depositing and developing a resist to form an etching pattern on the wafer (claimed depositing and removing portions of the resist layer to generate an etching pattern on the wafer); etching the wafer according to the etching pattern (col. 7, line 21-44; col. 8, line 20-30).

Referring to claims 2, 10, 29, 37, 55, 63, even though Liu is silent about the charged particle beam is of predetermined collimation and at a desired direction with respect to the wafer surface, the electron beam or ion implantation would have to carry a certain collimation and at a

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certain direction (claimed predetermined collimation at a desired direction) with respect to the wafer surface. Claims 14, 41, 67 do not have patentable weight because it is an optional limitation.

Referring to claims 3, 4, the wafer would comprise a negative of a final nanomachined structure for the depositing of metal interconnection (col. 7, line 51-59).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 9, 11, 13, 36, 38, 40, 62, 64, 66 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu as applied to claims 1, 10, 28, 37, 55, 63 above, and further in view of Zandveld (US 4, 104,085).

The ion implantation taught by Liu is known to one skilled in the art. Zandveld describes such ion implantation method using argon ions (col. 3, line 64-68). This would read on claimed charged particle beam is produced by removing some or all electron from neutral atoms. Method, such as using an accelerator, to produce such ions are known by one skilled in the art as shown in page 9, line 1-2 of specification.

Referring to claims 11, 13, 38, 40, 64, 66 figure 2 from Zandveld shows the direction is perpendicular to the wafer surface and the particle tracks formed would be substantially parallel to each other.

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6. Claims 15, 17, 19-22, 42, 44, 46-49, 68, 70, 72-75 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Zandveld as applied to claims 1, 28, 55 above, and further in view of Hashimoto et al. (US 4,976,818).

The process of forming pattern in the photoresist is known to one skilled in the art as describes here by Hashimoto. This process include spin coating, electron beam exposure, and develop in a solvent (col. 2, line 46-54).

Hashimoto also teaches using multi-layer resist system because it improves dry etch resistance and suppress the proximity effect due to reflection of electrons. The multi resist system is processed with dissolution of selective portions of the resist layer using a solvent and a plasma based etching (col. 1, line 18-31; summery; col. 2, line 39-61).

7. Claims 23-25, 50-52, 76-78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu as applied to claims 1, 28, 55 above, and further in view of applicant's admitted prior art.

Referring to claims 23, 50, 76 Liu is silent about the chemistry being used for etching of the wafer. Method for etching the wafer including an etching solution or plasma is well known to one skilled in the art as described in page 13 of the specification. Therefore, at the time of the invention, using any method will be obvious in order to etch the wafer with a reasonable expectation of success. Also, the since the etched portion would have to be correspondent to that of the etched pattern, it would be the same as that of the etched pattern.

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8. Claims 5, 6, 26, 27, 32, 33, 53, 54, 58, 59, 79, 80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Liu/admitted prior art as applied to claims 1, 25, 28, 52, 57, 78 above, and further in view of Chen (US 5, 723,387).

Liu doesn't describe the electroplating method for forming the Cu. Chen teaches an electroplating method for forming Cu interconnects (claims 6, 7). It would have been obvious for one skilled in the art to deposit Cu in light of Chen because Chen teaches that electroplating method can form very small scale Cu interconnects on semiconductor substrate.

9. Claims 12, 39, 65 rejected under 35 U.S.C. 103(a) as being unpatentable over Liu or Zandveld as applied to claims 10, 37, and 63 above.

Unlike claimed invention, Liu and Zandveld do not describe the direction of the particle beam hitting the substrate is of less than 90 degrees with respect to the plane of the wafer surface. However, the amount of particle beam hitting the wafer surface would depend on the angle it hits on the wafer; therefore, it would have been obvious for one skilled in the art to determine the angle the particle beam hitting the wafer surface through routine experimentation in order to obtain the optimum angle for the wafer surface treatment with a reasonable expectation of success.

Response to Arguments

10. Applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references.

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Applicant's argument that the formation of etchable particle tracks in the wafer the energetic changed particle beam is patently different from the localized surface radiation damage created by ion bombardment used to produce a gradient of etching rates in Zandveld is found unpersuasive because applicant has not shown evidence or comparison based on the process parameters of the Zandveld that would not form particle tracks in the wafer. Even though Zandveld doesn't describe the formation of particle tracks; however, as shown in the claims, the particle tracks are formed by irradiating the surface wafer with a charged particle beam, such as argon ions, of suitable energy. Since Zandveld's process does comprises of bombarding the surface of the wafer with argon ions (claimed irradiating the wafer with a charged particle beam) with a suitable energy of 20 keV with the depth of penetration of argon ions depending on ion concentration and energy, argon ions would form claimed particle tracks in the wafer.

Applicant's argument that support for the applicant's assertion that formation of particle tracks is not taught by Zandveld because Zandveld's starting material is an n-type conductive silicon plate and the specification describes that metals or silicon would not typically be suitable materials for particle (track) etching. This is found unpersuasive because the material that being subjected to form particle track in Zandveld is not n-type conductive silicon but silicon (di)oxide (insulator) that is exactly taught by the applicant. "The materials must be insulators or weak semiconductor," (specification, page 9, line 8-9).

Figure 2 in Zandveld shows a predetermined collimation beam and a perpendicular direction with respect to the wafer surface. Also, the ion beam must be oriented in a desired direction in order to hit the wafer.

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Applicant's argument about Liu's method does not form particle tracks is found unpersuasive because applicant has not shown evidence or comparison based on the process parameters of the Liu that would not form particle tracks in the wafer. Even though Liu doesn't describe the formation of particle tracks; however, as shown in the claims, the particle tracks are formed by irradiating the surface wafer with a charged particle beam of suitable energy to break the chemical bonds of the material. Since Liu's process does comprises of electron beam irradiation or ion implantation (claimed irradiating the wafer with a charged particle beam) that results in the conversion of the topmost layer of the dielectric layer into a hardmask (col. 6, line 44-65). Liu's charged particle beam would have to break the chemical bonds of the dielectric layer in order to form a hardmask. This would be the same as that of claimed reaction and therefore would form particle tracks in the wafer.

The particle beam in Liu must have a predetermined direction with respect to the wafer in order to hit the wafer.

Claims 14, 41, and 67 do not carry patentable weight because these limitations are not necessary to be a part of the process as described in the claims.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

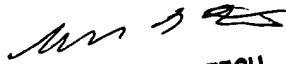
A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO**

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MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DuyVu n Deo whose telephone number is 703-305-0515.

DVD
July 17, 2003


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